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GB 1380376 A US 5365735 A US 4803189 A
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(54) Abstract Title
Catalytic converter arrangement

(57) A catalytic converter arrangement for the exhaust gas system of a motor vehicle having an internal combustion engine, in particular an Otto-cycle engine, in which exhaust gases are guided in first and second feed lines to the catalytic converter, the catalytic converter has a substantially rotationally symmetrical honeycomb body (3) with a first passage line (1) and a second passage line (2) which are at least approximately gas-tightly closed off relative to each other and which each have a plurality of passages connecting an intake end (14) of the honeycomb body and an outlet end (15) of the honeycomb body (3), the first and the second feed lines are connected at the intake end to the first and second passage lines respectively, the first passage line (1) is disposed substantially coaxially in the interior of the second passage line (2) and the hydraulic diameters of the first passage line (1) and the second passage line (2) are approximately equal.

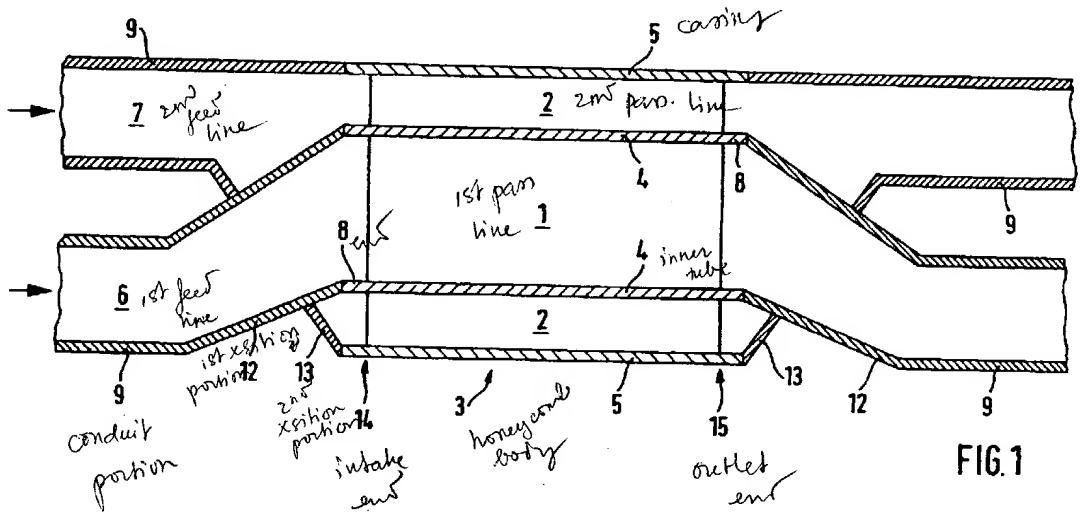

FIG.1

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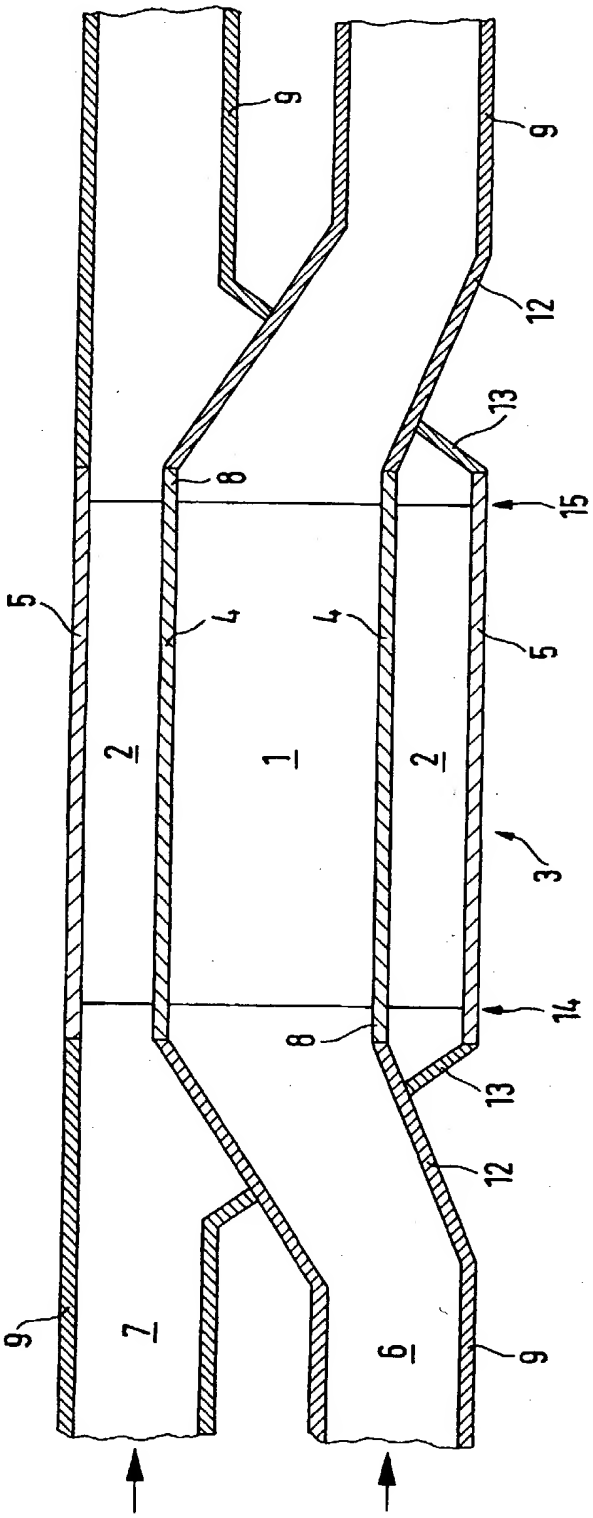

FIG.1

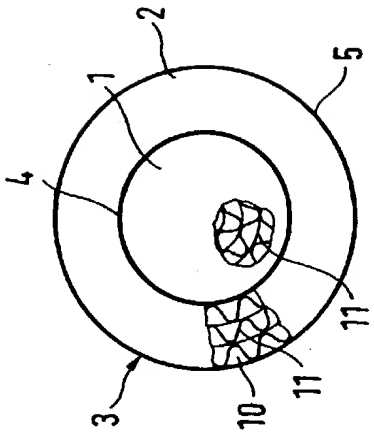

FIG.2

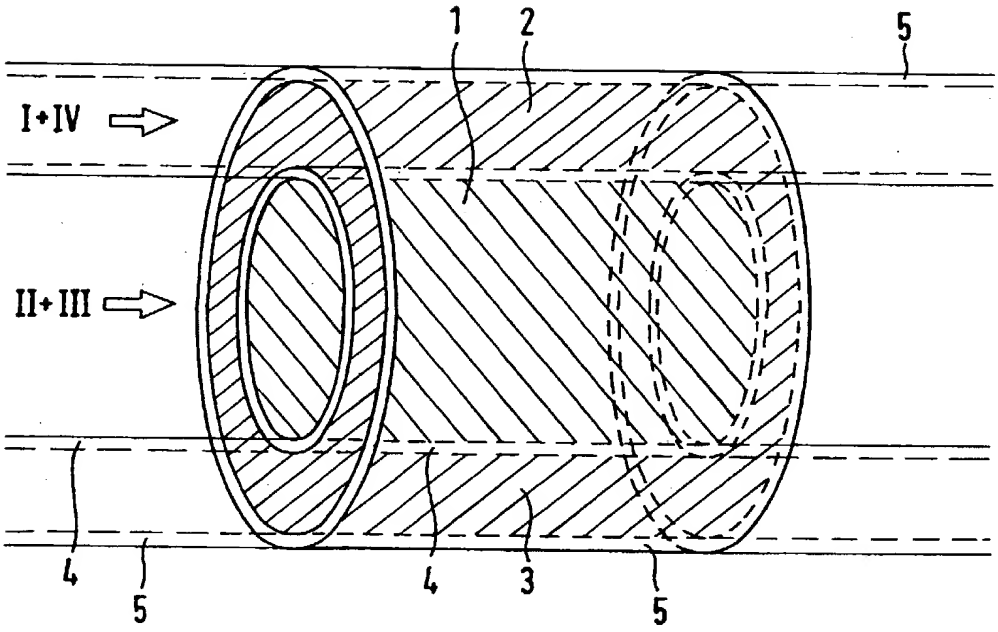

FIG.3

CATALYTIC CONVERTER ARRANGEMENT

The invention relates to a catalytic converter arrangement for the exhaust gas system of a motor vehicle with an internal combustion engine, such as an Otto-cycle engine.

Catalytic converters for the conversion of exhaust gases, which include a honeycomb body having a plurality of passages through which a fluid can flow, are known for example from Patent Specification EP-B-0 049 489. The honeycomb bodies preferably comprise sheet metal layers, wherein at least a part of the sheet metal layers is at least partially structured so that the passages are formed between the sheet metal layers.

Furthermore Patent Specification EP 0 245 783 B1 discloses a catalytic converter arrangement for exhaust gas systems of motor vehicles, in which the exhaust gas is guided at least in portions of the exhaust gas system in at least two separate exhaust gas lines wherein disposed in each exhaust gas line is at least one passage line or passage array of a catalytic converter which has a plurality of passages through which the exhaust gas can flow. The passage lines or passage arrays are disposed in a common casing, being separated from each other by approximately flat separating walls.

Also known are exhaust gas systems having two or more lines, wherein a respective specific catalytic converter is arranged in each exhaust gas line. Particularly in the case of catalytic converters which are disposed near the engine, the exhaust gases are frequently passed in dual lines to a position beyond the catalytic converter or converters in order to avoid torque losses. In that respect, attention is to be paid to the catalytic converter or converters being of the smallest possible external surface area so that heat losses at the outside surfaces due to radiant heat dissipation are as low as possible. In addition the catalytic converter or converters should be of the lowest possible thermal capacity in order to reach the ignition temperature at which the catalytic procedure commences as early as possible in the starting phases of the internal combustion engine. Furthermore the cross-sectional surface area of the catalytic converter or converters, which is available for the

exhaust gas flow, should be utilised as well as possible even in the edge regions of the passage lines or arrays.

According to the invention there is provided a catalytic converter arrangement for the exhaust gas system of a motor vehicle with an internal combustion engine, in which in use exhaust gases are guided in both a first feed line and a second feed line to the catalytic converter, the catalytic converter has a substantially rotationally symmetrical honeycomb body with a first passage line and a second passage line which are at least approximately gas-tightly closed off relative to each other and which each have a plurality of passages connecting an intake end of the honeycomb body and an outlet end of the honeycomb body, the first feed line and the second feed line are connected at the intake end to the first passage line and the second passage line respectively, the first passage line is disposed substantially coaxially in the interior of the second passage line and the hydraulic diameters of the first passage line and the second passage line are approximately equal.

In such an arrangement the external surfaces areas of the passage lines can be small, the passage lines can have a low thermal capacity and good use can be made of the flow cross-section available for exhaust gas flow.

Thus the exhaust gases of the internal combustion engine are guided to the exhaust gas catalytic converter in a first feed line and a second feed line, the catalytic converter has a rotationally symmetrical honeycomb body with a first passage line or array and a second passage line or array which are at least approximately gas-tightly sealed off relative to each other and which each have a plurality of passages connecting an intake end of the honeycomb body and an outlet end of the honeycomb body. The first feed line is connected at the intake end to the first passage line which is guided substantially co-axially in the interior of the second passage line. The second feed line is connected at the intake end to the second passage line. The hydraulic diameters of the first and second passage lines are approximately equal. The term hydraulic diameter is used to denote the diameter of a passage of circular cross-section which, with the same passage length, produces the same pressure drop for a flow.

Various configurations of the catalytic converter arrangement are possibly

using different honeycomb bodies. When using a honeycomb body in which the passages are almost all of approximately the same cross-sectional areas, the cross-sectional areas of the first and second passage lines are approximately equal.

By virtue of the rotational symmetry of the honeycomb body it has an advantageous relationship in respect of its external periphery to its cross-sectional area and thus also an advantageous relationship in respect of its external surface area to its volume. Preferably the external surface is approximately a cylindrical external surface. As the first passage line is guided in the interior of the second passage line the heat losses of the first passage line in operation of the catalytic converter arrangement are extremely low. It is even possible for the first passage line to receive heat from the second passage line surrounding it, more specifically when the exhaust gases which flow through the second passage line are at a higher temperature than the exhaust gases flowing through the first passage line. Considerable heat losses therefore occur only at the second passage line, by way of the external surface thereof.

Preferred honeycomb bodies are those with good thermal insulation, for example by virtue of a double-wall casing, as described in Patent Specification DE 44 45 557 A1. Another possible way of providing for good thermal insulation is to provide at the external periphery of the second passage line additional passages through which exhaust gas cannot flow, for example by applying structured and non-structured sheet metal layers which are wound therearound.

An advantage of the catalytic converter arrangement according to the invention is that the thermal capacity in the region of the catalytic converter can be low. Due to the compact arrangement of the two passages lines, little material is required in the passage lines for mechanical stabilization of the honeycomb body and for connection of the passage lines of the honeycomb body to the exhaust gas system. A saving in material denotes at the same time a reduction in thermal capacity.

Particularly in the case of laminar exhaust gas flows in the feed lines, in the case of previously known catalytic converter arrangements the exhaust gases flow through the edge regions at the external surfaces of the passages lines more slowly than the inner regions. The catalytic converter arrangement according to the

invention can counteract that uneven utilization of the available flow cross-section by virtue of the fact that the exhaust gas which flows in the second feed line is compelled to flow to the outer region of the honeycomb body.

In an embodiment of the catalytic converter arrangement according to the invention the honeycomb body has a cylindrical inner tube which is disposed coaxially in the interior of the second passage line and which embraces the first passage line and connects the ends of the honeycomb body together. The cylindrical inner tube has an end which projects out at the intake end of the honeycomb body. It is possible for example for connecting portions which connect the passage lines to the feed lines to be welded or soldered to said end. There are also design configurations in which the end, together with the connecting portion or portions, forms an approximately sealing sliding fit.

In a further embodiment of the catalytic converter arrangement the first and the second feed lines, at least in a portion directly upstream of the honeycomb body, pass through a coaxial tube with a cylindrical inner tube and a cylindrical outer tube which is coaxial with respect thereto, wherein the first feed line passes through the inner tube. A preferred development of this embodiment is a construction in which the diameter of the inner tube and the outer tube respectively are equal to the diameter of the first passage line and the second passage line respectively. The honeycomb body preferably has a tubular casing which contains the two passage lines. The outer tube of the coaxial tube is welded, soldered or flange-connected to the tubular casing.

In yet another configuration of the catalytic converter arrangement the first and the second feed lines each have in a portion thereof a first and a second conduit portion respectively which are of approximately the same cross-section, the second feed line has a second transitional portion which connects the second conduit portion to the second passage portion in gas-tight relationship relative to the exterior and the first feed line has a first transitional portion which, passing through the wall of the first transitional portion, connects the first conduit portion to the first passage line in gas-tight relationship relative to the exterior and in at least approximately gas-tight relationship with respect to the second feed line. In a development of that

configuration the first and the second conduit portions are disposed in a common outer tube. An advantage of this development is that the outer tube forms an insulation for the two conduit portions and that the two conduit portions can have thin external walls as the outer tube mechanically stabilizes the conduit portions. In yet a further development the two conduit portions are each of a semicircular cross-section and approximately fill a circular internal cross-section of the outer tube.

In still a further embodiment of the catalytic converter arrangement the honeycomb body is a metallic honeycomb body with wound and/or layered sheet metal layers of which at least a portion are structured sheet metal layers so that the passages are formed between the sheet metal layers. Honeycomb bodies of that kind are known for example from Patent Specifications DE 42 23 134 and EP-B-0 049 489.

There are further embodiments with further forms of connection for the feed lines to the passage lines. The honeycomb body is slotted in an annular configuration at the intake end and with the first feed line forms an almost sealing sliding fit. In accordance with another possible form of connection the catalytic converter arrangement has at the intake end a cylindrical ring of the same diameter as the first passage line which is connected to the honeycomb body by way of holding elements which project into passages in the honeycomb body.

Advantageously a catalytic converter arrangement in accordance with the invention is used with a four-cylinder in-line internal combustion engine with cylinders which are successively identified as I through IV and wherein cylinders I and IV are connected to the first passage line and cylinders II and III are connected to the second passage line. By virtue of the edge or boundary situation of the cylinders I and IV the exhaust gases from those cylinders are at a higher temperature than the exhaust gases from cylinders II and III. In order to reach the ignition temperature as early as possible in the start-up phase in both passage lines, the exhaust gases at higher temperature are passed into the second passage line at which substantially higher heat losses occur.

Embodiments of the catalytic converter arrangement according to the invention are described by way of example with reference to the accompanying drawings,

wherein:-

Figure 1 shows a catalytic converter arrangement according to the invention with conduit portions of the feed lines, which conduit portions are spatially separated from each other in regard to parts thereof,

Figure 2 is a view in cross-section of the catalytic converter, and

Figure 3 shows a catalytic converter with a coaxial connecting tube.

The catalytic converter arrangement shown in Figure 1 has an approximately rotationally symmetrical honeycomb body 3 with a cylindrical tubular casing 5 and a cylindrical inner tube 4 which is coaxial with respect thereto. That configuration thus forms a first inner passage line or array 1 and a second outer passage line or array 2. The exhaust gas feed and the exhaust gas discharge are symmetrical with respect to the honeycomb body. The left-hand side in Figure 1 shows the exhaust gas feed with a first feed line 6 and a second feed line 7. At the left-hand edge in Figure 1, the first feed line 6 and the second feed line 7 each have a respective conduit portion 9 which are approximately of the same cylindrical cross-section. The conduit portion 9 of the second feed line 7 goes into a second transitional portion 13 which connects the conduit portion 9 to the second passage line 2 in gas-tight relationship relative to the exterior. The conduit portion 9 of the first feed line 6 goes into a first transitional portion 12 which connects the conduit portion 9 to the first passage line in gas-tight relationship relative to the exterior and also in gas-tight relationship relative to the second feed line. In that arrangement the first transitional portion 12 passes through the wall of the second transitional portion 13.

At an intake end 14 the cylindrical inner tube 4 projects with an end 8 out of the honeycomb body 5. The transitional portion 12 is gas-tightly soldered or welded to the end 8, around same. It is however also possible for the transitional portion 12 and the end 8 to form an approximately gas-tight sliding fit, for example by the end 8 having a slot extending therearound in its end portion, and by the transitional portion 12 having a correspondingly shaped annular end which fits into the slot. In that way play can be allowed for different variations in length of the first and second exhaust gas lines, as a result of temperature differences. The second transitional portion 13 is preferably welded to the tubular casing 5.

The connection of the exhaust gas discharge to an outlet end 15 of the honeycomb body 3 is designed in mirror-image relationship with respect to the catalytic converter 3, but otherwise is like the exhaust gas feed at the intake end 14.

The cross-sectional view in Figure 2 shows the preferred structure of the honeycomb body 3 with wound or coiled and layered sheet metal layers 11 of which approximately half are structured layers so that passages 10 are formed between the layers 11.

The honeycomb body 3 shown in Figure 3 is connected to the coaxial tube 4, 5 comprising the cylindrical inner tube 4 and the cylindrical outer tube 5 which is coaxial with respect thereto. Its passage lines 1 and 2 are connected to the cylinders of a four-cylinder in-line engine. The cylinders are successively numbered as I through IV. In operation of the internal combustion engine, the exhaust gases from cylinders I and IV flow through the outer passage line 2, as is indicated by "I + IV" and by an arrow in Figure 3. The exhaust gases from cylinders II and III correspondingly flow through the passage line 1.

A catalytic converter arrangement according to the invention, while being of a compact structure, can permit conversion of the exhaust gases at a position close to the engine, with low heat losses due to radiation and with approximately uniform distribution of the exhaust gas flows over the cross-section of the honeycomb body.

CLAIMS

1. A catalytic converter arrangement for the exhaust gas system of a motor vehicle with an internal combustion engine, in which in use exhaust gases are guided in both a first feed line and a second feed line to the catalytic converter, the catalytic converter has a substantially rotationally symmetrical honeycomb body with a first passage line and a second passage line which are at least approximately gas-tightly closed off relative to each other and which each have a plurality of passages connecting an intake end of the honeycomb body and an outlet end of the honeycomb body, the first feed line and the second feed line are connected at the intake end to the first passage line and the second passage line respectively, the first passage line is disposed substantially coaxially in the interior of the second passage line and the hydraulic diameters of the first passage line and the second passage line are approximately equal.

2. A catalytic converter arrangement according to claim 1 in which almost all passages of the honeycomb body, which are arranged in the first passage line or the second passage line, are of approximately the same cross-section, and the cross-sectional areas of the passage lines are approximately equal.

3. A catalytic converter arrangement according to claim 1 or claim 2, in which the honeycomb body is slotted in an annular configuration at the intake end and with the first feed line forms an almost sealing sliding fit.

4. A catalytic converter arrangement according to claim 1 or claim 2, in which the honeycomb body has a cylindrical inner tube which is disposed coaxially in the interior of the second passage line and which surrounds the first passage line, which connects the ends of the honeycomb body together and which at the intake end has an end which projects out of the honeycomb body.

5. A catalytic converter arrangement according to any one of claims 1 to 4, in

which the first feed line and the second feed line, at least in a portion immediately in front of the honeycomb body, pass through a coaxial tube with a cylindrical inner tube and a cylindrical outer tube which is coaxial with respect thereto, and the first feed line passes through the inner tube.

6. A catalytic converter arrangement according to any one of claims 1 to 4, in which the first feed line and the second feed line each have a first and a second conduit portion which are of approximately the same cross-section, the second feed line has a second transitional portion which connects the second conduit portion to the second passage line in gas-tight relationship relative to the exterior and the first feed line has a first transitional portion which, passing through the wall of the second transitional portion, connects the first conduit portion to the first passage line in gas-tight relationship relative to the exterior and at least approximately in gas-tight relationship relative to the second feed line.

7. A catalytic converter arrangement according to claim 6, in which the first and second conduit portions are disposed in a common outer tube.

8. A catalytic converter arrangement according to any one of claims 1 to 7, in which the honeycomb body is a metallic honeycomb body with wound and/or layered sheet metal layers of which at least a portion are structured sheet metal layers so that the passages are formed between the sheet metal layers.

9. An exhaust gas system with a catalytic converter arrangement according to any one of claims 1 to 8 in which the internal combustion engine is a four-cylinder in-line engine with cylinders successively identified as I to IV and cylinders I and IV are connected to the first passage line and cylinders II and III are connected to the second passage line.

10. A catalytic converter arrangement for the exhaust gas system of a motor vehicle with an internal combustion engine substantially as hereinbefore described and illustrated with reference to the accompanying drawings.

The Patent Office

10

Application No: GB 9726250.5 **Examiner:** Jeremy Philpott
Claims searched: 1-10 **Date of search:** 25 March 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): B1W [WD, WX]; B1F [FD1B, FD1X1, F2D2]

Int Cl (Ed.6): F01N: 3/24, 3/28

Other: On-line: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB 1380376 A	(Chemical Construction Corporation) whole document & Figures.	
A	US 5365735	(Ford Motor Company) whole document & Figures, note especially Figure 4.	
A	US 4803189	(Interatom GmbH) whole document & Figures, note especially Figure 17.	
A	US 4625511	(Arvin Industries) whole document & Figures.	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.